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IS 4730 (1994): Methods for determination of density of liquids [CHD 1: Inorganic Chemicals]



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IS 4730 : 1994
(Reaffirmed 2003)

भारतीय मानक

द्रव का घनत्व ज्ञात करने की पद्धति

(पहला पुनरीक्षण)

Indian Standard

**METHOD FOR DETERMINATION OF
DENSITY OF LIQUIDS**

(*First Revision*)

UDC 532.14

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 3

FOREWORD

This Indian Standard (First Revision) was adopted by Bureau of Indian Standards, after the draft finalized by Chemical Standards Sectional Committee had been approved by the Chemical Division Council.

This standard was first published in 1968. The technical committee responsible for the preparation of this standard felt the need to revise this standard to keep pace with ISO standard on this subject. In this revision, the Table 1 Density of water has been suitably modified in addition to the density of air at 27°C and 760 mm Hg pressure.

While density at a specified temperature is a fundamental molecular property of a given substance, the product specification generally and for good reasons include relative density at a specified temperature say, 20°C/20°C or 27°C/27°C, etc, that is.

$$\frac{\text{density of substance at the specified temperature}}{\text{density of water at the specified temperature}}$$

This is because the accuracy of the relative density is independent of the accuracy of the density bottle or pycnometer.

The technical committee, the composition of which is given in Annex A, responsible for formulation of this Indian Standard is working on to incorporate a suitable formula for evaluation of relative density at a specified temperature in a product specification when relative density is conveniently measured at ambient temperature.

This standard is based on the ISO 758 Method for determination of density of liquids at 20°C. In order to obtain uniformity of methods in Indian Standards and also international agreement on the methods where possible, the details of the method prescribed by ISO have largely been left unchanged except at a few places where change is called for to suit Indian conditions.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it should be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

METHOD FOR DETERMINATION OF DENSITY OF LIQUIDS

(First Revision)

1 SCOPE

This standard prescribes a reference method for the determination of the density of liquids for industrial use with an accuracy of 0.05 percent.

2 REFERENCE

IS 1070 : 1992 Specification for reagent grade water (*third revision*) is the referred Indian Standard to this standard.

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definition shall apply.

3.1 Density = m/v

The density of a material at given temperature is the mass of unit volume of the material at that temperature. It is expressed in kilogram per cubic meter (kg/m^3). The submultiple gram per cubic centimeter (g/cm^3), for which symbol 'g/ml' is also commonly used.

NOTE — The term millilitre (ml) is commonly used as special name for cubic centimeter (cm^3).

4 PRINCIPLE

Determination of the mass at a given temperature of a volume of the material contained in a density bottle and determination of the volume of the latter by determining the mass of the corresponding volume of water at the same temperature. The density is obtained by dividing the mass of material by its volume.

5 APPARATUS**5.1 Density Bottle**

Closed type, made of glass and of a size and type suitable for use with the material under test.

5.2 Water-Bath

Thermostatically controlled with an accuracy of $\pm 0.1^\circ\text{C}$.

6 PROCEDURE

6.1 Clean and dry the density bottle and weigh it with its stopper to the nearest milligram. Fill the bottle with freshly boiled and cooled distilled water (*see* IS 1070 : 1992) at the desired temperature and determine the apparent mass of the contents.

6.2 Clean and dry the density bottle, fill it with the sample under test, and determine, in a similar manner the apparent mass of sample contained in the bottle at the same temperature.

NOTES

1 With volatile liquids, suitable precautions should be taken to avoid loss by evaporation.

2 Whenever the density determination is carried out at a temperature other than the room temperature, ensure that the temperature of the sample, water and the bottle does not change during the test by keeping them in the constant temperature bath.

7 CALCULATION

7.1 Calculate the density of the sample at $t^\circ\text{C}$ from the following formula and report the results correct to 3 places of decimal.

$$\text{Density (} t_w \text{) of sample, } \rho_{tw} = \frac{(M_1 + A)}{(M_2 + A)} \times \rho_{tw}$$

where

M_1 = apparent mass in g of the sample required to fill the bottle at $t^\circ\text{C}$;

M_2 = apparent mass in g of the water required to fill the bottle at $t^\circ\text{C}$;

ρ_{tw} = density of water at $t^\circ\text{C}$ (*see* Table 1);

A = buoyancy correction $\rho_{at} \times M_2$; and

ρ_{at} = density of air at 27°C and 760 mm Hg pressure = $0.001\,168\,\text{g/cm}^3$.

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Table 1 Density of Water
(Clause 7.1)

t°C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Mean Value kgm ⁻³ k ⁻¹	Air Saturated Air-free kgm ⁻³
0	999.839 6	999.846 3	999.852 8	999.859 1	999.865 3	999.871 3	999.877 1	999.882 7	999.888 2	999.893 5	0.059	-0.004 6
1	999.898 6	999.903 5	999.908 2	999.912 8	999.917 2	999.921 4	999.925 4	999.929 3	999.933 0	999.936 5	0.041	-0.004 5
2	999.939 9	999.943 1	999.946 1	999.949 0	999.951 6	999.954 2	999.956 5	999.958 7	999.960 7	999.962 5	0.024	-0.004 4
3	999.964 2	999.965 7	999.967 1	999.968 2	999.969 3	999.970 1	999.970 8	999.971 3	999.971 7	999.971 9	0.008	-0.004 3
4	999.972 0	999.971 8	999.971 6	999.971 1	999.970 5	999.969 8	999.968 9	999.967 8	999.966 6	999.965 2	-0.008	-0.004 2
5	999.963 7	999.962 0	999.960 2	999.958 2	999.956 0	999.953 7	999.951 3	999.948 6	999.945 9	999.943 0	-0.024	-0.004 1
6	999.939 9	999.936 7	999.933 3	999.929 8	999.926 1	999.922 3	999.918 4	999.914 3	999.910 0	999.905 6	-0.039	-0.004 0
7	999.901 1	999.896 4	999.891 5	999.886 5	999.881 4	999.876 1	999.870 7	999.865 1	999.859 4	999.853 6	-0.053	-0.003 9
8	999.847 6	999.841 5	999.835 2	999.828 8	999.822 2	999.815 5	999.808 7	999.801 7	999.794 6	999.787 3	-0.068	-0.003 8
9	999.779 9	999.772 4	999.764 7	999.756 9	999.749 0	999.740 9	999.732 7	999.724 4	999.715 9	999.707 3	-0.081	-0.003 7
10	999.698 5	999.689 6	999.680 6	999.671 4	999.662 2	999.652 7	999.643 2	999.633 5	999.623 7	999.613 7	-0.095	-0.003 6
11	999.603 7	999.593 4	999.583 1	999.572 6	999.562 0	999.551 3	999.540 5	999.529 5	999.518 4	999.507 1	-0.108	-0.003 4
12	999.495 8	999.484 3	999.472 6	999.460 9	999.449 0	999.437 0	999.424 9	999.412 7	999.400 3	999.387 8	-0.121	-0.003 3
13	999.375 2	999.36 24	999.349 5	999.336 6	999.323 4	999.310 2	999.296 8	999.283 4	999.269 8	999.256 0	-0.133	-0.003 2
14	999.242 2	999.228 2	999.214 1	999.199 9	999.185 6	999.171 2	999.156 6	999.141 9	999.127 1	999.112 2	-0.145	-0.003 1
15	999.097 2	999.082 0	999.066 7	999.051 3	999.035 8	999.020 2	999.004 5	998.988 6	998.972 6	998.956 6	-0.157	-0.003 0
16	998.940 4	998.924 0	998.907 6	998.891 1	998.874 4	998.857 6	998.840 7	998.823 7	998.806 6	998.789 4	-0.168	-0.002 9
17	998.772 1	998.754 6	998.737 1	998.719 4	998.701 6	998.683 7	998.665 7	998.647 6	998.629 3	998.611 0	-0.180	-0.002 8
18	998.592 6	998.574 0	998.555 3	998.536 5	998.517 7	998.498 7	998.479 6	998.460 4	998.441 0	998.421 6	-0.190	-0.002 7
19	998.402 1	998.382 4	998.362 7	998.342 8	998.322 9	998.302 8	998.282 6	998.262 3	998.241 9	998.221 4	-0.201	-0.002 6
20	998.200 8	998.180 1	998.159 3	998.138 4	998.117 4	998.096 3	998.075 1	998.053 7	998.032 3	998.010 8	-0.212	-0.002 5
21	997.989 1	997.967 4	997.945 5	997.923 6	997.901 5	997.879 4	997.857 1	997.834 8	997.812 3	997.789 8	-0.222	-0.002 4
22	997.767 1	997.744 3	997.721 5	997.698 5	997.675 5	997.652 3	997.629 0	997.605 7	997.582 2	997.558 6	-0.232	-0.002 3
23	997.535 0	997.511 2	997.487 4	997.463 4	997.439 4	997.415 2	997.391 0	997.366 6	997.342 2	997.317 6	-0.242	-0.002 2
24	997.293 0	997.268 3	997.243 4	997.218 5	997.193 5	997.168 3	997.143 1	997.117 8	997.092 4	997.066 9	-0.252	-0.002 1
25	997.041 3	997.015 6	996.989 8	996.963 9	996.937 9	996.911 8	996.885 7	996.859 4	996.833 0	996.806 6	-0.261	-0.002 0
26	996.780 0	996.753 4	996.746 7	996.699 8	996.672 9	996.645 9	996.618 8	996.591 6	996.564 3	996.536 9	-0.271	
27	996.509 5	996.481 9	996.454 2	996.426 5	996.398 6	996.370 7	996.342 7	996.314 6	996.286 4	996.258 1	-0.280	
28	996.229 7	996.201 2	996.172 6	996.144 0	996.115 2	996.086 4	996.057 4	996.028 4	995.999 3	995.970 1	-0.289	
29	995.940 8	995.911 5	995.882 0	995.852 5	995.822 8	995.793 1	995.763 3	995.733 4	995.703 4	995.673 3	-0.298	
30	995.643 1	995.612 9	995.582 6	995.552 1	995.521 6	995.491 0	995.460 3	995.429 6	995.398 7	995.367 7	-0.306	
31	995.336 7	995.305 6	995.274 4	995.243 1	995.211 7	995.180 3	995.148 7	995.117 1	995.085 4	995.053 6	-0.315	
32	995.021 7	994.989 7	994.957 7	994.925 5	994.893 3	994.861 0	994.828 6	994.796 2	994.763 6	994.731 0	-0.323	
33	994.698 3	994.665 4	994.632 6	994.599 6	994.566 5	994.533 4	994.500 2	994.466 9	994.433 5	994.400 0	-0.332	
34	994.366 5	994.332 9	994.299 2	994.265 4	994.231 5	994.197 6	994.163 5	994.129 4	994.095 2	994.060 9	-0.340	
35	994.026 6	993.992 2	993.957 6	993.923 1	993.888 4	993.853 6	993.818 8	993.783 9	993.748 9	993.713 8	-0.348	
36	994.678 7	993.643 4	993.608 1	993.572 8	993.537 3	993.501 8	993.466 1	993.430 4	993.394 7	993.358 8	-0.356	
37	993.322 9	993.286 9	993.250 8	993.214 6	993.178 4	993.142 1	993.105 7	993.069 2	993.032 7	992.996 1	-0.364	
38	993.959 4	992.922 6	992.885 7	992.848 8	992.811 8	992.774 7	992.737 6	992.700 4	992.663 1	992.625 7	-0.371	
39	992.588 2	992.550 7	992.513 1	992.475 5	992.437 7	992.399 9	992.362 0	992.324 0	992.286 0	992.247 9	-0.379	
40	992.209 7											
40		991.826	991.432	991.031	990.623	990.208	989.786	989.358	988.922	988.479		
50	988.030	987.575	987.113	986.644	986.169	985.688	985.201	984.707	984.208	983.702		
60	983.191	982.673	982.150	981.621	981.086	980.546	979.999	979.448	978.890	978.327		
70	977.759	977.185	976.606	976.022	975.432	974.837	974.237	973.632	973.021	972.405		
80	971.785	971.159	970.528	969.892	969.252	968.606	967.955	967.300	966.639	965.974		
90	965.304	964.630	963.950	963.266	962.577	961.883	961.185	960.482	959.774	959.062		
100	958.345											

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ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Composition of Chemical Standards Sectional Committee, CHD 001

<i>Chairman</i>	<i>Representing</i>
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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	{ 37 84 99, 37 85 61 37 86 26, 37 86 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	{ 53 38 43, 53 16 40 53 23 84
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	{ 235 02 16, 235 04 42 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) BOMBAY 400093	{ 632 92 95, 632 78 58 632 78 91, 632 78 92
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